SEQUENCE LISTING

<110> AKZO Nobel N.V.

<120> Lawsonia intracellularis vaccine

<130> Lawsonia intracellularis vaccine

<140>
<141>

<160> 20

<170> PatentIn Ver. 2.1

<210> 1
<211> 656
<212> DNA
<213> Lawsonia intracellularis

<220>
<221> CDS
<222> (1)..(654)

<400> 1

```
gcg gag gtg acg gcg agt tgt act aaa cgt gtt gaa agc tat aat tat      48
Ala Glu Val Thr Ala Ser Cys Thr Lys Arg Val Glu Ser Tyr Asn Tyr
 1               5                  10                  15


ctt gtg gat tat tca ggc tct atg atg atg aaa cat gtt gct gtt aga      96
Leu Val Asp Tyr Ser Gly Ser Met Met Met Lys His Val Ala Val Arg
                20                  25                  30


gag cct aaa ata gaa tta gca aaa gaa gct ata tta aaa att aat gcg     144
Glu Pro Lys Ile Glu Leu Ala Lys Glu Ala Ile Leu Lys Ile Asn Ala
            35                  40                  45


gca atg cct aaa atg tca tat caa ggt gga tta tat act ttt gca cct     192
Ala Met Pro Lys Met Ser Tyr Gln Gly Gly Leu Tyr Thr Phe Ala Pro
        50                  55                  60


tat tct gta att att ccc caa ggt tct tgg aat tca tgt gtt gcc gaa     240
Tyr Ser Val Ile Ile Pro Gln Gly Ser Trp Asn Ser Cys Val Ala Glu
 65                  70                  75                  80


tgt gcg gtt aat aca att aag tct gat tta gaa att ttt ggt cgt ctt     288
Cys Ala Val Asn Thr Ile Lys Ser Asp Leu Glu Ile Phe Gly Arg Leu
                85                  90                  95
```

1

```
act cct gtg gga gac ggc ata aaa atg cat gaa aca gtc att aat caa    336
Thr Pro Val Gly Asp Gly Ile Lys Met His Glu Thr Val Ile Asn Gln
        100             105             110

atg ccc cct cag gca gcc gtt att ctt ctc act gat ggt cat aat aat    384
Met Pro Pro Gln Ala Ala Val Ile Leu Leu Thr Asp Gly His Asn Asn
        115             120             125

tta ggg atg aat cct gtt gag gaa gta aaa tct ata tat caa aca aat    432
Leu Gly Met Asn Pro Val Glu Glu Val Lys Ser Ile Tyr Gln Thr Asn
        130             135             140

cct aat gtt tgt ttt cat gta gtt tca ttt gca gat gat gct gaa ggc    480
Pro Asn Val Cys Phe His Val Val Ser Phe Ala Asp Asp Ala Glu Gly
145             150             155             160

aaa gca ata att gat caa att gtt gca ctt aat agt gga agt gtt ctt    528
Lys Ala Ile Ile Asp Gln Ile Val Ala Leu Asn Ser Gly Ser Val Leu
                165             170             175

gtt gat ggt tta cag ctt cta caa aat cct gct gtt tgc caa gaa ttt    576
Val Asp Gly Leu Gln Leu Leu Gln Asn Pro Ala Val Cys Gln Glu Phe
        180             185             190

gtt aat agt gtt ttt tgt caa gag caa att ctt gtt aca gaa gaa gtt    624
Val Asn Ser Val Phe Cys Gln Glu Gln Ile Leu Val Thr Glu Glu Val
        195             200             205

gtt gta ctt cgt ggc gtc aac ttt gcc ttc ga                        656
Val Val Leu Arg Gly Val Asn Phe Ala Phe
        210             215


<210> 2
<211> 218
<212> PRT
<213> Lawsonia intracellularis

<400> 2
Ala Glu Val Thr Ala Ser Cys Thr Lys Arg Val Glu Ser Tyr Asn Tyr
 1               5               10              15

Leu Val Asp Tyr Ser Gly Ser Met Met Met Lys His Val Ala Val Arg
        20              25              30

Glu Pro Lys Ile Glu Leu Ala Lys Glu Ala Ile Leu Lys Ile Asn Ala
        35              40              45
```

2

```
Ala Met Pro Lys Met Ser Tyr Gln Gly Gly Leu Tyr Thr Phe Ala Pro
     50              55              60

Tyr Ser Val Ile Ile Pro Gln Gly Ser Trp Asn Ser Cys Val Ala Glu
 65              70              75              80

Cys Ala Val Asn Thr Ile Lys Ser Asp Leu Glu Ile Phe Gly Arg Leu
             85              90                  95

Thr Pro Val Gly Asp Gly Ile Lys Met His Glu Thr Val Ile Asn Gln
         100             105             110

Met Pro Pro Gln Ala Ala Val Ile Leu Leu Thr Asp Gly His Asn Asn
         115             120             125

Leu Gly Met Asn Pro Val Glu Glu Val Lys Ser Ile Tyr Gln Thr Asn
     130             135             140

Pro Asn Val Cys Phe His Val Val Ser Phe Ala Asp Asp Ala Glu Gly
145             150             155             160

Lys Ala Ile Ile Asp Gln Ile Val Ala Leu Asn Ser Gly Ser Val Leu
             165             170             175

Val Asp Gly Leu Gln Leu Leu Gln Asn Pro Ala Val Cys Gln Glu Phe
         180             185             190

Val Asn Ser Val Phe Cys Gln Glu Gln Ile Leu Val Thr Glu Glu Val
         195             200             205

Val Val Leu Arg Gly Val Asn Phe Ala Phe
    210             215
```

```
<210> 3
<211> 1428
<212> DNA
<213> Lawsonia intracellularis

<220>
<221> CDS
<222> (1)..(1425)

<400> 3
gct att gat ttt aag gca aag ggg gtg tgg gac ttc aat ttt gag tgg      48
Ala Ile Asp Phe Lys Ala Lys Gly Val Trp Asp Phe Asn Phe Glu Trp
```

caa caa tct agt ttt atg aag ggc gat gga gat caa cgt ttt tcg cct   96
Gln Gln Ser Ser Phe Met Lys Gly Asp Gly Asp Gln Arg Phe Ser Pro
            20   25   30

aaa caa cgt tta cgt act caa ata gac att gtt gca tca gag agt ctt   144
Lys Gln Arg Leu Arg Thr Gln Ile Asp Ile Val Ala Ser Glu Ser Leu
            35   40   45

aag ggt gtt gta ttc ttt gaa tta ggt aag act atc tgg gga cgt ggt   192
Lys Gly Val Val Phe Phe Glu Leu Gly Lys Thr Ile Trp Gly Arg Gly
        50   55   60

gtt gat ggt gct tct att gga aca gat ggt aaa aat gtt ata aag ctc   240
Val Asp Gly Ala Ser Ile Gly Thr Asp Gly Lys Asn Val Ile Lys Leu
65   70   75   80

cgt tat tcc tat gtt gat tgg gtt att cct tac aca gat gtg caa gtc   288
Arg Tyr Ser Tyr Val Asp Trp Val Ile Pro Tyr Thr Asp Val Gln Val
                85   90   95

cgt atg ggt tta caa cct tat gtc ctt cca gga ttt gtt gca ggt tct   336
Arg Met Gly Leu Gln Pro Tyr Val Leu Pro Gly Phe Val Ala Gly Ser
            100   105   110

aca ata tta gat gct gat gga gca ggt gtt act gtt tct gct gta ttt   384
Thr Ile Leu Asp Ala Asp Gly Ala Gly Val Thr Val Ser Ala Val Phe
            115   120   125

aat gat tat tta ggt gct aca gct ttc tgg atg cgt gca ttg cat aaa   432
Asn Asp Tyr Leu Gly Ala Thr Ala Phe Trp Met Arg Ala Leu His Lys
        130   135   140

aac tat gat agt aat tat gga ata tca aag cta cct aac ttt aaa ggt   480
Asn Tyr Asp Ser Asn Tyr Gly Ile Ser Lys Leu Pro Asn Phe Lys Gly
145   150   155   160

aca aca tta gat gta gtt gga tta act att cct gta aca ata tct gat   528
Thr Thr Leu Asp Val Val Gly Leu Thr Ile Pro Val Thr Ile Ser Asp
            165   170   175

ata aaa att gct cca tgg ggt atg ttt gct ttt gca ggt aag aag agc   576
Ile Lys Ile Ala Pro Trp Gly Met Phe Ala Phe Ala Gly Lys Lys Ser
            180   185   190

tta tta ggg gaa agc tat gga gat att gaa gat gta aga gca ggt ctt   624
Leu Leu Gly Glu Ser Tyr Gly Asp Ile Glu Asp Val Arg Ala Gly Leu

4

```
tta cca gca atg cca gca gga ttt gga tat agc tgg gga gct ggt aat    672
Leu Pro Ala Met Pro Ala Gly Phe Gly Tyr Ser Trp Gly Ala Gly Asn
    210             215             220


cca ttt gga gat gtt ttt cca aat aaa aag cgt ggt aat gca tgg tgg    720
Pro Phe Gly Asp Val Phe Pro Asn Lys Lys Arg Gly Asn Ala Trp Trp
225             230             235             240


gtt ggt tta tca gct gaa ctt gct ggc tca agt cct ttg cat ata gct    768
Val Gly Leu Ser Ala Glu Leu Ala Gly Ser Ser Pro Leu His Ile Ala
            245             250             255


gtt gat ggt gct tat gga cga gca gac tta gga agt ctt aga aat gtt    816
Val Asp Gly Ala Tyr Gly Arg Ala Asp Leu Gly Ser Leu Arg Asn Val
            260             265             270


gtt att ggt gac ttc tta cta gat aag att gat tta aaa cgt caa ggt    864
Val Ile Gly Asp Phe Leu Leu Asp Lys Ile Asp Leu Lys Arg Gln Gly
        275             280             285


tgg tat gca gca tta tta gca gaa tat aaa ttt gaa tat gta act cca    912
Trp Tyr Ala Ala Leu Leu Ala Glu Tyr Lys Phe Glu Tyr Val Thr Pro
    290             295             300


ggg gtt ata ggt tgg tat gcc tca gga gat aaa gtt gat tca cgt ggc    960
Gly Val Ile Gly Trp Tyr Ala Ser Gly Asp Lys Val Asp Ser Arg Gly
305             310             315             320


gcc tct aaa aga ata cca aca tta gtt gga aac tgg tca gca aca agt   1008
Ala Ser Lys Arg Ile Pro Thr Leu Val Gly Asn Trp Ser Ala Thr Ser
            325             330             335


ttt gga tat agt gga gcc tat ggt ata ggc aaa gat tct gtt ttt gga   1056
Phe Gly Tyr Ser Gly Ala Tyr Gly Ile Gly Lys Asp Ser Val Phe Gly
            340             345             350


aat act att gct ggc tca tgg ggt gtt gta gtt cag ttg aaa gat att   1104
Asn Thr Ile Ala Gly Ser Trp Gly Val Val Val Gln Leu Lys Asp Ile
            355             360             365


tct ttc tta gaa aat cta act cat gtt atc cgt gga gct aga att cag   1152
Ser Phe Leu Glu Asn Leu Thr His Val Ile Arg Gly Ala Arg Ile Gln
    370             375             380


ggt aca aat aat aaa gac gtt cct gaa cac tta ggt tta tca tac gtt   1200
Gly Thr Asn Asn Lys Asp Val Pro Glu His Leu Gly Leu Ser Tyr Val
```

5

```
act acc att tat gac aca cgt ggt ggt gat aat atg ctt tac tta aca    1248
Thr Thr Ile Tyr Asp Thr Arg Gly Gly Asp Asn Met Leu Tyr Leu Thr
                405                     410                 415

aag aaa gat tat gct tgg gaa gta gat ttt gat act gaa tat aaa atc    1296
Lys Lys Asp Tyr Ala Trp Glu Val Asp Phe Asp Thr Glu Tyr Lys Ile
                420                     425                 430

tat aaa gac tta agt gta gct ctt gaa ctg tca tat att cgt ctt gaa    1344
Tyr Lys Asp Leu Ser Val Ala Leu Glu Leu Ser Tyr Ile Arg Leu Glu
                435                     440                 445

ctt gat aaa aaa cta tgg aac ctt caa aga gaa gtt gat aag aat gcc    1392
Leu Asp Lys Lys Leu Trp Asn Leu Gln Arg Glu Val Asp Lys Asn Ala
                450                     455                 460

tat cgt gct ggt tta aat atg aag tat caa ttc taa                    1428
Tyr Arg Ala Gly Leu Asn Met Lys Tyr Gln Phe
465                     470                 475
```

<210> 4
<211> 475
<212> PRT
<213> Lawsonia intracellularis

<400> 4

```
Ala Ile Asp Phe Lys Ala Lys Gly Val Trp Asp Phe Asn Phe Glu Trp
 1               5                   10                  15

Gln Gln Ser Ser Phe Met Lys Gly Asp Gly Asp Gln Arg Phe Ser Pro
            20                  25                  30

Lys Gln Arg Leu Arg Thr Gln Ile Asp Ile Val Ala Ser Glu Ser Leu
        35                  40                  45

Lys Gly Val Val Phe Phe Glu Leu Gly Lys Thr Ile Trp Gly Arg Gly
    50                  55                  60

Val Asp Gly Ala Ser Ile Gly Thr Asp Gly Lys Asn Val Ile Lys Leu
65                  70                  75                  80

Arg Tyr Ser Tyr Val Asp Trp Val Ile Pro Tyr Thr Asp Val Gln Val
                85                  90                  95

Arg Met Gly Leu Gln Pro Tyr Val Leu Pro Gly Phe Val Ala Gly Ser
```

6

```
               100                    105                    110
Thr Ile Leu Asp Ala Asp Gly Ala Gly Val Thr Val Ser Ala Val Phe
        115                    120                    125

Asn Asp Tyr Leu Gly Ala Thr Ala Phe Trp Met Arg Ala Leu His Lys
        130                    135                    140

Asn Tyr Asp Ser Asn Tyr Gly Ile Ser Lys Leu Pro Asn Phe Lys Gly
145                    150                    155                    160

Thr Thr Leu Asp Val Val Gly Leu Thr Ile Pro Val Thr Ile Ser Asp
                165                    170                    175

Ile Lys Ile Ala Pro Trp Gly Met Phe Ala Phe Ala Gly Lys Lys Ser
            180                    185                    190

Leu Leu Gly Glu Ser Tyr Gly Asp Ile Glu Asp Val Arg Ala Gly Leu
        195                    200                    205

Leu Pro Ala Met Pro Ala Gly Phe Gly Tyr Ser Trp Gly Ala Gly Asn
        210                    215                    220

Pro Phe Gly Asp Val Phe Pro Asn Lys Lys Arg Gly Asn Ala Trp Trp
225                    230                    235                    240

Val Gly Leu Ser Ala Glu Leu Ala Gly Ser Ser Pro Leu His Ile Ala
                245                    250                    255

Val Asp Gly Ala Tyr Gly Arg Ala Asp Leu Gly Ser Leu Arg Asn Val
            260                    265                    270

Val Ile Gly Asp Phe Leu Leu Asp Lys Ile Asp Leu Lys Arg Gln Gly
            275                    280                    285

Trp Tyr Ala Ala Leu Leu Ala Glu Tyr Lys Phe Glu Tyr Val Thr Pro
        290                    295                    300

Gly Val Ile Gly Trp Tyr Ala Ser Gly Asp Lys Val Asp Ser Arg Gly
305                    310                    315                    320

Ala Ser Lys Arg Ile Pro Thr Leu Val Gly Asn Trp Ser Ala Thr Ser
            325                    330                    335

Phe Gly Tyr Ser Gly Ala Tyr Gly Ile Gly Lys Asp Ser Val Phe Gly
            340                    345                    350

Asn Thr Ile Ala Gly Ser Trp Gly Val Val Val Gln Leu Lys Asp Ile
```

7

Ser Phe Leu Glu Asn Leu Thr His Val Ile Arg Gly Ala Arg Ile Gln
    370   375   380

Gly Thr Asn Asn Lys Asp Val Pro Glu His Leu Gly Leu Ser Tyr Val
385   390   395   400

Thr Thr Ile Tyr Asp Thr Arg Gly Gly Asp Asn Met Leu Tyr Leu Thr
                405   410   415

Lys Lys Asp Tyr Ala Trp Glu Val Asp Phe Asp Thr Glu Tyr Lys Ile
                420   425   430

Tyr Lys Asp Leu Ser Val Ala Leu Glu Leu Ser Tyr Ile Arg Leu Glu
        435   440   445

Leu Asp Lys Lys Leu Trp Asn Leu Gln Arg Glu Val Asp Lys Asn Ala
    450   455   460

Tyr Arg Ala Gly Leu Asn Met Lys Tyr Gln Phe
465   470   475

<210> 5
<211> 12
<212> PRT
<213> Lawsonia intracellularis

<400> 5
Ala Ala Tyr Glu Tyr Leu Val Met Leu Gly Val Asn
  1   5   10

<210> 6
<211> 12
<212> PRT
<213> Lawsonia intracellularis

<400> 6
Gly Thr Gln Glu Tyr Asn Leu Ala Leu Gly Glu Arg
  1   5   10

<210> 7

<211> 11
<212> PRT
<213> Lawsonia intracellularis

<400> 7
Pro Phe Tyr Val Met Val Trp Thr Pro Arg Arg
 1   5   10

<210> 8
<211> 20
<212> DNA
<213> Lawsonia intracellularis

<400> 8
tatagctgtt gatggtgctt   20

<210> 9
<211> 19
<212> DNA
<213> Lawsonia intracellularis

<400> 9
ggtgataata tgctttact   19

<210> 10
<211> 19
<212> DNA
<213> Lawsonia intracellularis

<400> 10
atatggggggg ggggggggg   19

<210> 11
<211> 31
<212> DNA
<213> Lawsonia intracellularis

<400> 11
ggaattccat atgtattgat tttaaggcaa a   31

<210> 12
<211> 30

9

<212> DNA
<213> Lawsonia intracellularis

<400> 12
cgcggatccg cgatccttga taattcaagg   30

<210> 13
<211> 36
<212> DNA
<213> Lawsonia intracellularis

<400> 13
ggaattccat atgaaaatga aaaagagcac tctggc   36

<210> 14
<211> 30
<212> DNA
<213> Lawsonia intracellularis

<400> 14
ccgctcgagg aattgatact tcatatttaa   30

<210> 15
<211> 12
<212> PRT
<213> Lawsonia intracellularis

<400> 15
Ala Glu Val Thr Ala Ser Cys Thr Lys Arg Val Gly
  1   5   10

<210> 16
<211> 16
<212> PRT
<213> Lawsonia intracellularis

<400> 16
Gly Val Asn Phe Ala Phe Asp Ser Phe Ala Leu Asp Asp Thr Ala Lys
  1   5   10   15

<210> 17

10

<211> 12
<212> PRT
<213> Lawsonia intracellularis

<400> 17
Ile Asp Phe Lys Ala Lys Gly Val Trp Asp Phe Asn
 1   5   10

<210> 18
<211> 11
<212> PRT
<213> Lawsonia intracellularis

<400> 18
Lys Asp Tyr Ala Trp Glu Val Asp Phe Asp Thr
 1   5   10

<210> 19
<211> 12
<212> PRT
<213> Lawsonia intracellularis

<400> 19
Ala Ala Tyr Glu Tyr Leu Val Met Leu Gly Val Asn
 1   5   10

<210> 20
<211> 12
<212> PRT
<213> Lawsonia intracellularis

<400> 20
Gly Thr Gln Glu Tyr Asn Leu Ala Leu Gly Glu Arg
 1   5   10

SEQUENCE LISTING

<110> JACOBS, Antonius A.C.
      VERMEIJ, Paul

<120> LAWSONIA INTRACELLULARIS VACCINE

<130> JACOBS ET AL.

<140> To be assigned
<141> 2001-12-20

<150> EP00204660.5
<151> 2000-12-20

<160> 20

<170> PatentIn Ver. 2.1

<210> 1
<211> 656
<212> DNA
<213> Lawsonia intracellularis

<220>
<221> CDS
<222> (1)..(654)

<400> 1
gcg gag gtg acg gcg agt tgt act aaa cgt gtt gaa agc tat aat tat   48
Ala Glu Val Thr Ala Ser Cys Thr Lys Arg Val Glu Ser Tyr Asn Tyr
 1   5   10   15

ctt gtg gat tat tca ggc tct atg atg atg aaa cat gtt gct gtt aga   96
Leu Val Asp Tyr Ser Gly Ser Met Met Met Lys His Val Ala Val Arg
             20   25   30

gag cct aaa ata gaa tta gca aaa gaa gct ata tta aaa att aat gcg   144
Glu Pro Lys Ile Glu Leu Ala Lys Glu Ala Ile Leu Lys Ile Asn Ala
         35   40   45

gca atg cct aaa atg tca tat caa ggt gga tta tat act ttt gca cct   192
Ala Met Pro Lys Met Ser Tyr Gln Gly Gly Leu Tyr Thr Phe Ala Pro
     50   55   60

tat tct gta att att ccc caa ggt tct tgg aat tca tgt gtt gcc gaa   240
Tyr Ser Val Ile Ile Pro Gln Gly Ser Trp Asn Ser Cys Val Ala Glu
 65   70   75   80

1

```
tgt gcg gtt aat aca att aag tct gat tta gaa att ttt ggt cgt ctt    288
Cys Ala Val Asn Thr Ile Lys Ser Asp Leu Glu Ile Phe Gly Arg Leu
                85                  90                  95

act cct gtg gga gac ggc ata aaa atg cat gaa aca gtc att aat caa    336
Thr Pro Val Gly Asp Gly Ile Lys Met His Glu Thr Val Ile Asn Gln
            100                 105                 110

atg ccc cct cag gca gcc gtt att ctt ctc act gat ggt cat aat aat    384
Met Pro Pro Gln Ala Ala Val Ile Leu Leu Thr Asp Gly His Asn Asn
            115                 120                 125

tta ggg atg aat cct gtt gag gaa gta aaa tct ata tat caa aca aat    432
Leu Gly Met Asn Pro Val Glu Glu Val Lys Ser Ile Tyr Gln Thr Asn
        130                 135                 140

cct aat gtt tgt ttt cat gta gtt tca ttt gca gat gat gct gaa ggc    480
Pro Asn Val Cys Phe His Val Val Ser Phe Ala Asp Asp Ala Glu Gly
145                 150                 155                 160

aaa gca ata att gat caa att gtt gca ctt aat agt gga agt gtt ctt    528
Lys Ala Ile Ile Asp Gln Ile Val Ala Leu Asn Ser Gly Ser Val Leu
                165                 170                 175

gtt gat ggt tta cag ctt cta caa aat cct gct gtt tgc caa gaa ttt    576
Val Asp Gly Leu Gln Leu Leu Gln Asn Pro Ala Val Cys Gln Glu Phe
            180                 185                 190

gtt aat agt gtt ttt tgt caa gag caa att ctt gtt aca gaa gaa gtt    624
Val Asn Ser Val Phe Cys Gln Glu Gln Ile Leu Val Thr Glu Glu Val
        195                 200                 205

gtt gta ctt cgt ggc gtc aac ttt gcc ttc ga                        656
Val Val Leu Arg Gly Val Asn Phe Ala Phe
    210                 215


<210> 2
<211> 218
<212> PRT
<213> Lawsonia intracellularis

<400> 2
Ala Glu Val Thr Ala Ser Cys Thr Lys Arg Val Glu Ser Tyr Asn Tyr
  1               5                  10                  15


Leu Val Asp Tyr Ser Gly Ser Met Met Met Lys His Val Ala Val Arg
```

Glu Pro Lys Ile Glu Leu Ala Lys Glu Ala Ile Leu Lys Ile Asn Ala
        35   40   45

Ala Met Pro Lys Met Ser Tyr Gln Gly Gly Leu Tyr Thr Phe Ala Pro
        50   55   60

Tyr Ser Val Ile Ile Pro Gln Gly Ser Trp Asn Ser Cys Val Ala Glu
65   70   75   80

Cys Ala Val Asn Thr Ile Lys Ser Asp Leu Glu Ile Phe Gly Arg Leu
                85   90   95

Thr Pro Val Gly Asp Gly Ile Lys Met His Glu Thr Val Ile Asn Gln
            100   105   110

Met Pro Pro Gln Ala Ala Val Ile Leu Leu Thr Asp Gly His Asn Asn
        115   120   125

Leu Gly Met Asn Pro Val Glu Glu Val Lys Ser Ile Tyr Gln Thr Asn
    130   135   140

Pro Asn Val Cys Phe His Val Val Ser Phe Ala Asp Asp Ala Glu Gly
145   150   155   160

Lys Ala Ile Ile Asp Gln Ile Val Ala Leu Asn Ser Gly Ser Val Leu
            165   170   175

Val Asp Gly Leu Gln Leu Leu Gln Asn Pro Ala Val Cys Gln Glu Phe
            180   185   190

Val Asn Ser Val Phe Cys Gln Glu Gln Ile Leu Val Thr Glu Glu Val
        195   200   205

Val Val Leu Arg Gly Val Asn Phe Ala Phe
    210   215

<210> 3
<211> 1428
<212> DNA
<213> Lawsonia intracellularis

<220>
<221> CDS
<222> (1)..(1425)

3

<400> 3
```
gct att gat ttt aag gca aag ggg gtg tgg gac ttc aat ttt gag tgg     48
Ala Ile Asp Phe Lys Ala Lys Gly Val Trp Asp Phe Asn Phe Glu Trp
 1               5                   10                  15


caa caa tct agt ttt atg aag ggc gat gga gat caa cgt ttt tcg cct     96
Gln Gln Ser Ser Phe Met Lys Gly Asp Gly Asp Gln Arg Phe Ser Pro
                20                  25                  30


aaa caa cgt tta cgt act caa ata gac att gtt gca tca gag agt ctt    144
Lys Gln Arg Leu Arg Thr Gln Ile Asp Ile Val Ala Ser Glu Ser Leu
            35                  40                  45


aag ggt gtt gta ttc ttt gaa tta ggt aag act atc tgg gga cgt ggt    192
Lys Gly Val Val Phe Phe Glu Leu Gly Lys Thr Ile Trp Gly Arg Gly
        50                  55                  60


gtt gat ggt gct tct att gga aca gat ggt aaa aat gtt ata aag ctc    240
Val Asp Gly Ala Ser Ile Gly Thr Asp Gly Lys Asn Val Ile Lys Leu
 65                  70                  75                  80


cgt tat tcc tat gtt gat tgg gtt att cct tac aca gat gtg caa gtc    288
Arg Tyr Ser Tyr Val Asp Trp Val Ile Pro Tyr Thr Asp Val Gln Val
                85                  90                  95


cgt atg ggt tta caa cct tat gtc ctt cca gga ttt gtt gca ggt tct    336
Arg Met Gly Leu Gln Pro Tyr Val Leu Pro Gly Phe Val Ala Gly Ser
            100                 105                 110


aca ata tta gat gct gat gga gca ggt gtt act gtt tct gct gta ttt    384
Thr Ile Leu Asp Ala Asp Gly Ala Gly Val Thr Val Ser Ala Val Phe
            115                 120                 125


aat gat tat tta ggt gct aca gct ttc tgg atg cgt gca ttg cat aaa    432
Asn Asp Tyr Leu Gly Ala Thr Ala Phe Trp Met Arg Ala Leu His Lys
        130                 135                 140


aac tat gat agt aat tat gga ata tca aag cta cct aac ttt aaa ggt    480
Asn Tyr Asp Ser Asn Tyr Gly Ile Ser Lys Leu Pro Asn Phe Lys Gly
145                 150                 155                 160


aca aca tta gat gta gtt gga tta act att cct gta aca ata tct gat    528
Thr Thr Leu Asp Val Val Gly Leu Thr Ile Pro Val Thr Ile Ser Asp
            165                 170                 175


ata aaa att gct cca tgg ggt atg ttt gct ttt gca ggt aag aag agc    576
Ile Lys Ile Ala Pro Trp Gly Met Phe Ala Phe Ala Gly Lys Lys Ser
```

4

```
tta tta ggg gaa agc tat gga gat att gaa gat gta aga gca ggt ctt    624
Leu Leu Gly Glu Ser Tyr Gly Asp Ile Glu Asp Val Arg Ala Gly Leu
        195                   200                   205

tta cca gca atg cca gca gga ttt gga tat agc tgg gga gct ggt aat    672
Leu Pro Ala Met Pro Ala Gly Phe Gly Tyr Ser Trp Gly Ala Gly Asn
        210                   215                   220

cca ttt gga gat gtt ttt cca aat aaa aag cgt ggt aat gca tgg tgg    720
Pro Phe Gly Asp Val Phe Pro Asn Lys Lys Arg Gly Asn Ala Trp Trp
225                   230                   235                   240

gtt ggt tta tca gct gaa ctt gct ggc tca agt cct ttg cat ata gct    768
Val Gly Leu Ser Ala Glu Leu Ala Gly Ser Ser Pro Leu His Ile Ala
                245                   250                   255

gtt gat ggt gct tat gga cga gca gac tta gga agt ctt aga aat gtt    816
Val Asp Gly Ala Tyr Gly Arg Ala Asp Leu Gly Ser Leu Arg Asn Val
                260                   265                   270

gtt att ggt gac ttc tta cta gat aag att gat tta aaa cgt caa ggt    864
Val Ile Gly Asp Phe Leu Leu Asp Lys Ile Asp Leu Lys Arg Gln Gly
        275                   280                   285

tgg tat gca gca tta tta gca gaa tat aaa ttt gaa tat gta act cca    912
Trp Tyr Ala Ala Leu Leu Ala Glu Tyr Lys Phe Glu Tyr Val Thr Pro
        290                   295                   300

ggg gtt ata ggt tgg tat gcc tca gga gat aaa gtt gat tca cgt ggc    960
Gly Val Ile Gly Trp Tyr Ala Ser Gly Asp Lys Val Asp Ser Arg Gly
305                   310                   315                   320

gcc tct aaa aga ata cca aca tta gtt gga aac tgg tca gca aca agt    1008
Ala Ser Lys Arg Ile Pro Thr Leu Val Gly Asn Trp Ser Ala Thr Ser
                325                   330                   335

ttt gga tat agt gga gcc tat ggt ata ggc aaa gat tct gtt ttt gga    1056
Phe Gly Tyr Ser Gly Ala Tyr Gly Ile Gly Lys Asp Ser Val Phe Gly
                340                   345                   350

aat act att gct ggc tca tgg ggt gtt gta gtt cag ttg aaa gat att    1104
Asn Thr Ile Ala Gly Ser Trp Gly Val Val Val Gln Leu Lys Asp Ile
                355                   360                   365

tct ttc tta gaa aat cta act cat ggt atc cgt gga gct aga att cag    1152
Ser Phe Leu Glu Asn Leu Thr His Gly Ile Arg Gly Ala Arg Ile Gln
```

5

```
ggt aca aat aat aaa gac gtt cct gaa cac tta ggt tta tca tac gtt    1200
Gly Thr Asn Asn Lys Asp Val Pro Glu His Leu Gly Leu Ser Tyr Val
385             390             395             400


act acc att tat gac aca cgt ggt ggt gat aat atg ctt tac tta aca    1248
Thr Thr Ile Tyr Asp Thr Arg Gly Gly Asp Asn Met Leu Tyr Leu Thr
                405             410             415


aag aaa gat tat gct tgg gaa gta gat ttt gat act gaa tat aaa atc    1296
Lys Lys Asp Tyr Ala Trp Glu Val Asp Phe Asp Thr Glu Tyr Lys Ile
                420             425             430


tat aaa gac tta agt gta gct ctt gaa ctg tca tat att cgt ctt gaa    1344
Tyr Lys Asp Leu Ser Val Ala Leu Glu Leu Ser Tyr Ile Arg Leu Glu
            435             440             445


ctt gat aaa aaa cta tgg aac ctt caa aga gaa gtt gat aag aat gcc    1392
Leu Asp Lys Lys Leu Trp Asn Leu Gln Arg Glu Val Asp Lys Asn Ala
            450             455             460


tat cgt gct ggt tta aat atg aag tat caa ttc taa                    1428
Tyr Arg Ala Gly Leu Asn Met Lys Tyr Gln Phe
465             470             475
```

<210> 4
<211> 475
<212> PRT
<213> Lawsonia intracellularis

<400> 4
```
Ala Ile Asp Phe Lys Ala Lys Gly Val Trp Asp Phe Asn Phe Glu Trp
 1               5               10              15


Gln Gln Ser Ser Phe Met Lys Gly Asp Gly Asp Gln Arg Phe Ser Pro
            20              25              30


Lys Gln Arg Leu Arg Thr Gln Ile Asp Ile Val Ala Ser Glu Ser Leu
            35              40              45


Lys Gly Val Val Phe Phe Glu Leu Gly Lys Thr Ile Trp Gly Arg Gly
    50              55              60


Val Asp Gly Ala Ser Ile Gly Thr Asp Gly Lys Asn Val Ile Lys Leu
 65              70              75              80
```

Arg Tyr Ser Tyr Val Asp Trp Val Ile Pro Tyr Thr Asp Val Gln Val
            85   90   95

Arg Met Gly Leu Gln Pro Tyr Val Leu Pro Gly Phe Val Ala Gly Ser
            100   105   110

Thr Ile Leu Asp Ala Asp Gly Ala Gly Val Thr Val Ser Ala Val Phe
            115   120   125

Asn Asp Tyr Leu Gly Ala Thr Ala Phe Trp Met Arg Ala Leu His Lys
    130   135   140

Asn Tyr Asp Ser Asn Tyr Gly Ile Ser Lys Leu Pro Asn Phe Lys Gly
145   150   155   160

Thr Thr Leu Asp Val Val Gly Leu Thr Ile Pro Val Thr Ile Ser Asp
            165   170   175

Ile Lys Ile Ala Pro Trp Gly Met Phe Ala Phe Ala Gly Lys Lys Ser
            180   185   190

Leu Leu Gly Glu Ser Tyr Gly Asp Ile Glu Asp Val Arg Ala Gly Leu
            195   200   205

Leu Pro Ala Met Pro Ala Gly Phe Gly Tyr Ser Trp Gly Ala Gly Asn
    210   215   220

Pro Phe Gly Asp Val Phe Pro Asn Lys Lys Arg Gly Asn Ala Trp Trp
225   230   235   240

Val Gly Leu Ser Ala Glu Leu Ala Gly Ser Ser Pro Leu His Ile Ala
            245   250   255

Val Asp Gly Ala Tyr Gly Arg Ala Asp Leu Gly Ser Leu Arg Asn Val
            260   265   270

Val Ile Gly Asp Phe Leu Leu Asp Lys Ile Asp Leu Lys Arg Gln Gly
            275   280   285

Trp Tyr Ala Ala Leu Leu Ala Glu Tyr Lys Phe Glu Tyr Val Thr Pro
    290   295   300

Gly Val Ile Gly Trp Tyr Ala Ser Gly Asp Lys Val Asp Ser Arg Gly
305   310   315   320

Ala Ser Lys Arg Ile Pro Thr Leu Val Gly Asn Trp Ser Ala Thr Ser
            325   330   335

7

Phe Gly Tyr Ser Gly Ala Tyr Gly Ile Gly Lys Asp Ser Val Phe Gly
          340   345   350

Asn Thr Ile Ala Gly Ser Trp Gly Val Val Val Gln Leu Lys Asp Ile
          355   360   365

Ser Phe Leu Glu Asn Leu Thr His Gly Ile Arg Gly Ala Arg Ile Gln
    370   375   380

Gly Thr Asn Asn Lys Asp Val Pro Glu His Leu Gly Leu Ser Tyr Val
385   390   395   400

Thr Thr Ile Tyr Asp Thr Arg Gly Gly Asp Asn Met Leu Tyr Leu Thr
          405   410   415

Lys Lys Asp Tyr Ala Trp Glu Val Asp Phe Asp Thr Glu Tyr Lys Ile
          420   425   430

Tyr Lys Asp Leu Ser Val Ala Leu Glu Leu Ser Tyr Ile Arg Leu Glu
          435   440   445

Leu Asp Lys Lys Leu Trp Asn Leu Gln Arg Glu Val Asp Lys Asn Ala
    450   455   460

Tyr Arg Ala Gly Leu Asn Met Lys Tyr Gln Phe
465   470   475

<210> 5
<211> 12
<212> PRT
<213> Lawsonia intracellularis

<400> 5
Ala Ala Tyr Glu Tyr Leu Val Met Leu Gly Val Asn
  1   5   10

<210> 6
<211> 12
<212> PRT
<213> Lawsonia intracellularis

<400> 6
Gly Thr Gln Glu Tyr Asn Leu Ala Leu Gly Glu Arg
  1   5   10

8

```
<210> 7
<211> 11
<212> PRT
<213> Lawsonia intracellularis

<400> 7
Pro Phe Tyr Val Met Val Trp Thr Pro Arg Arg
 1               5                   10


<210> 8
<211> 20
<212> DNA
<213> Lawsonia intracellularis

<400> 8
tatagctgtt gatggtgctt                                          20


<210> 9
<211> 19
<212> DNA
<213> Lawsonia intracellularis

<400> 9
ggtgataata tgctttact                                           19


<210> 10
<211> 19
<212> DNA
<213> Lawsonia intracellularis

<400> 10
atatgggggg ggggggggg                                           19


<210> 11
<211> 31
<212> DNA
<213> Lawsonia intracellularis

<400> 11
ggaattccat atgtattgat tttaaggcaa a                             31


<210> 12
```

```
<211> 30
<212> DNA
<213> Lawsonia intracellularis

<400> 12
cgcggatccg cgatccttga taattcaagg                                    30


<210> 13
<211> 36
<212> DNA
<213> Lawsonia intracellularis

<400> 13
ggaattccat atgaaaatga aaaagagcac tctggc                            36


<210> 14
<211> 30
<212> DNA
<213> Lawsonia intracellularis

<400> 14
ccgctcgagg aattgatact tcatatttaa                                    30


<210> 15
<211> 12
<212> PRT
<213> Lawsonia intracellularis

<400> 15
Ala Glu Val Thr Ala Ser Cys Thr Lys Arg Val Gly
  1               5                  10


<210> 16
<211> 16
<212> PRT
<213> Lawsonia intracellularis

<400> 16
Gly Val Asn Phe Ala Phe Asp Ser Phe Ala Leu Asp Asp Thr Ala Lys
  1               5                  10                  15


<210> 17
<211> 12
```

<212> PRT
<213> Lawsonia intracellularis

<400> 17
Ile Asp Phe Lys Ala Lys Gly Val Trp Asp Phe Asn
 1   5   10

<210> 18
<211> 11
<212> PRT
<213> Lawsonia intracellularis

<400> 18
Lys Asp Tyr Ala Trp Glu Val Asp Phe Asp Thr
 1   5   10

<210> 19
<211> 12
<212> PRT
<213> Lawsonia intracellularis

<400> 19
Ala Ala Tyr Glu Tyr Leu Val Met Leu Gly Val Asn
 1   5   10

<210> 20
<211> 12
<212> PRT
<213> Lawsonia intracellularis

<400> 20
Gly Thr Gln Glu Tyr Asn Leu Ala Leu Gly Glu Arg
 1   5   10